SUSTAINED TREATMENT WITH GIBBERELLIC ACID OF FIVE DIFFERENT KINDS OF MAIZE*

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Profound morphological and physiological responses can be induced in many plants by application of the fungal metabolite gibberellic acid (hereinafter called GA). The history of GA has been summarized by Stowe and Yamaki (1957). They indicated that early Japanese work involving *Zea Mays* was performed with extracts prepared directly from cultures of the fungus *Gibberella fujikuroi* (Saw.) Wr. which had been isolated from rice plants, and was mainly concerned with effects on stem elongation. The fungus itself they cited as being reported on maize; indeed, the first valid description of its imperfect stage, designated *Fusarium moniliforme* Sheld., was made from infected maize. Morphological effects noted in these early reports were not consistent; artificial infections of maize with the fungus apparently caused overgrowth, while natural infections did not.

Applications of crystalline giberellins to intact maize plants have been reported by few workers. Marth et al. (1956) reported that treated maize responded with an increase in height, but that the effect diminished with time after treatment was stopped. Phinney (1956) was able to obtain a height increase in four genetically recessive dwarfs of maize by continued application to the plants of small amounts of GA every 3–4 days. He stated that a total of 60 micrograms was enough to cause a genetic dwarf *(dwarf-1)* plant to attain the same height as normal controls, and that this same dosage had no effect on genetically normal plants. Normal plants would, however, respond to increased doses by increase in height. Response of dwarf maize plants has been interpreted as an instance in higher plants where a gene defect in a stepwise series of biochemical reactions is overcome by the addition of GA (Brian and Grove, 1957).

Langridge (1955) interpreted in the same manner his finding that a simple mutant of *Arabidopsis thaliana* responded to thiamine to give normal growth. The response of dwarf *Lolium* to GA is another instance of this same phenomenon (Cooper, 1958). This explanation has not been deemed adequate, however, to explain the overcoming of dwarfness in peas, where several genes are involved (Brian, 1957, 1959). Moreover, other work with maize, reported elsewhere (Nickerson, 1959, in press) shows that GA effectively overcomes the characteristics of two dominant maize mutants, Teopod *(Te)* and Corn-grass *(Cg)*, rendering these genetic forms essentially normal in appearance.

Nelson and Rossman (1958) and Wittwer and Bukovac (1958) reported upon a hitherto unknown effect of GA. Male sterility was caused by treatment of normal sweet corn and inbred dent lines (R53 and OH51) when tassels were, according to the first authors, 1″ long and according to the second authors, 4–6 cm. long.

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Results reported below independently verify this effect of treatment with GA.

No study of the effects of various concentrations of GA on the external morphology of different kinds of corn grown under the same conditions exists. During the winter of 1956-57, a small pilot project was carried out on 64 plants of the sweet corn hybrid *Spancross* in the greenhouse of the Department of Botany, Cornell University, Ithaca, N. Y. Results obtained from treated plants were quite startling; tassel branches were not formed, ears were suppressed, tillers did not develop, and pistillate florets which formed viable caryopses developed in male-sterile tassels of plants which, compared to controls, averaged 50% taller. However, because of results reported by Schaffner (1927, 1930) on sex reversal in maize tassels under short days, of pictures of Singleton's (1946) normal greenhouse-grown plants which clearly show silks in the tassel, and of results noted by Went (1957), where the same induction of pistillate growth was obtained in tassels of plants grown at relatively low temperatures, a more comprehensive experiment under field conditions seemed warranted.

Materials and Methods:

Five kinds of maize were employed in this study. Two were representatives of the well-defined races (for discussion of the race concept in maize, see Anderson and Cutler, 1942) Northern Flint and Zapalote Chico. Parker's Flint was one of the Northern Flints studied by Brown and Anderson (1947); it was chosen because it was well adapted to the area in which the plants were to be grown. Zapalote Chico, studied by Wellhausen et al. (1951, 1952) was chosen because it was an extremely vigorous day-length-independent Mexican dent corn of different morphological type than most U. S. maize. Two other kinds were the inbreds Wisconsin CC5 and L317, chosen because of their widespread use by E. G. Anderson and others as standards in genetic studies (Nickerson and Dale, 1955). The fifth type was Spancross, the hybrid sweet corn mentioned above. Its pedigree and field behavior are well known (Enzie, 1943; Singleton, 1948).

Five plots of each kind of maize[1] were planted in a randomized field of twenty-five plots. Plots were four feet apart each way; the ten plants in each of the five rows of each plot were 20 inches apart each way. All plants in any one row of each plot were subjected to the same treatment. The distribution of treatments within each plot was also randomized. Five treatments were employed:

1 — distilled water (controls)
2 — distilled water with 5 ppm GA
3 — distilled water with 25 ppm GA
4 — distilled water with 125 ppm GA
5 — distilled water with 625 ppm GA

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[1] Grateful acknowledgement is made to the following individuals for their cooperation in supplying seed: Dr. Wm. L. Brown, Pioneer Hi-Bred Corn Co., Johnston, Iowa, for Parker's Flint and CC5; Dr. Willis Skrdla, Plant Introduction Station, Iowa State Colleges, Ames, Iowa, for Zapalote Chico (P. I. 217413); Professor A. A. Johnson, Dept. of Plant Breeding, Cornell University, Ithaca, N. Y., for L317. Spancross seed was purchased from GLF Seed Store, Ithaca, New York.

Every three days one ml. of the appropriate solution, which contained the above-listed concentration as micrograms of GA, was applied from a pipette into the apical leaf cavity of each of the 1250 plants used. The solutions were freshly made each week, and kept in darkness at 19° C.[2] To eliminate any possible effect of interaction between insecticides, fungicides and GA, no spraying was done either for fungi, of which none was noted, or for insects, of which both corn earworm and corn borer were noted. Fertilizer (Agrico 5-10-10) was applied at the rate of 600 lbs. per acre three and six weeks after germination. Planting date was June 8, 1958; treatments began June 24 and continued until tassel emergence (Table 1).

TABLE 1

TOTAL AMOUNT OF GA RECEIVED BY EACH PLANT IN MICROGRAMS

	No. of Treatments	Amount of GA per treatment				
		0	5	25	125	625
Spancross	12	0	60	300	1500	7500
Parker's Flint	14	0	70	350	1750	8750
Zapalote Chico	17	0	85	425	2125	10625
CC5	19	0	95	475	2375	11875
L317	19	0	95	475	2375	11875

Results:

No differences in response were noted among each of the five plots of any one kind of maize. Agreement was very close as to height of plants, internode lengths, numbers of tassel branches, ears and tillers, rapidity of effects of GA, and effects noted at each concentration employed. The results are therefore attributed directly to the treatment given rather than to any environmental variation. In determining average effects (Tables 2–6), all plants of one kind which received a particular treatment were included, regardless of location in the field. Wind damage was due to brittleness of treated plants; to assure some survivors, as many as possible, beginning with the plants receiving the highest concentrations and working down, were staked and tied. These lines are noticeable on some of the figures (Plates 6–10).

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[2] The GA employed was kindly supplied by Dr. Curt Leben, Agricultural Research Division, Eli Lilly and Co., Greenfield, Indiana.

Hybrid Spancross. (Tables 1, 2; Fig. 1, Plate 6). Treatments with 25 ppm were most effective in promoting stem elongation; higher concentrations induced poor overall vegetative growth and reduced ear and tiller formation. Adventitious brace or prop roots were formed only on the two lower nodes of controls, but they appeared at all nodes below the ear on plants given GA. Tassel branch reduction was linearly related to increased concentrations. Male sterility and development of pistillate florets also increased with increased concentrations. The terminal inflorescences produced, having few or no primary branches, pistillate spikelets below and staminate spikelets above, greatly resembled those of *Tripsacum-Zea* hybrids (Mangelsdorf and Reeves, 1939; see their figure 31.). Rachises in these treated tassels may be disarticulated into segments in the same manner as those of *Tripsacum* inflorescences. Spikelets, however, are in pairs, and may be either both pistillate (as in several tassel-seed mutants) or the member of a pair may be pistillate and the pedicellate staminate (as in Tassel-seed 3; Nickerson & Dale, 1955). Cupules (Nickerson, 1954; Galinat, 1956) were developed in both instances. Worm damage was general in ears and some tassels; damaged plants were excluded from Table 2 below. Ears of controls and the first two concentrations were apparently identical; those from 125 ppm plants were smaller than control ears. Ears from 625 ppm plants were small, with aborted apices, and resembling strawberry pop ears in shape.

Parker's Flint. (Tables 1, 3; Fig. 1; Plates 5, 7). The 25 ppm treatment was most effective in promoting stem elongation and development of basal internodes. This effect extended to tassel branches which were ¼ to ½ again as long as those of controls. Brace roots appeared as far as 30 cm. above ground on the lower 3–4 nodes of treated plants; controls showed brace root development on only the two lowest nodes. Average tiller number, ear number and tassel branch number decreased with increasing treatment. Male sterility was more prominent than development of female spikelets, but the latter did occur. The two higher treatments tended to produce thin spindly plants with long, narrow, often rolled leaves; many plants were rejected because of failure to extrude tassels. Dissections of these plants revealed only rudiments of tassels present. The 125 ppm treatment seemed to be more detrimental to growth than the 625 ppm treatment. Worm damage, especially to ears, was most extensive in this group. Ears of controls and of the first two treatments were alike in appearance. Ears of 125 ppm plants were about half the size of controls. Ears of 625 ppm plants did not mature. Tillers (axillary shoots) were apparently induced to develop after unintentional decapitation by wind breakage occurred on plants receiving higher treatments. This effect of axillary suppression in intact plants and stimulation in decapitated ones was noted in peas by Brian et al. (1955) and Brian (1957). This same phenomenon occurred also in three other types listed below, all normally tillerless.

Zapalote Chico. (Tables 1, 4; Fig. 1; Plate 8). The 125 ppm treatment was most effective in promoting stem elongation; an average height nearly double that of controls was noted. The greatest number of nodes was likewise formed under this treatment. All extra nodes were below the point of attachment of the ear. Brace roots appeared in controls and on 5 ppm plants on the two lowermost nodes. All other treated plants developed brace roots on the lower 4–6 nodes, at distances as high as 70–100 cm. above the ground. Width of leaves was reduced to 3–4 cm., while controls had leaves 6–9 cm. wide. Average number of ears and tassel branch number decreased, while male sterility and pistillate spikelet development increased with increasing treatment strength. Damage from wind was high in the tall plants, where internodal diameters averages less than 1 cm. compared to 2.5–3.5 cm. of controls. This maize was the most vigorous of the five types here considered; plants formed excellent ears and tassels completely free from worm damage. Most exclusions in this group resulted from non-exsertion of tassels and failure of tassels to develop anything more than primordia of branches and florets. Most of these latter ones were pistillate, but had neither cupules nor functional parts. Ears of controls and of the first two treatments were alike in appearance. Ears of 125 ppm plants were reduced in size and in fertility; few caryopses formed. Ears of 625 ppm plants did not mature.

Inbred CC5. (Tables 1, 5; Fig. 1; Plate 9). No significant increase in height with increasing dosage was noted. Plants normally do not form tillers, and did not with treatment. Brace roots were formed at the lowest two nodes on controls, at the lowest 3–4 nodes with 5 ppm treatment and at the lowest 4–7 nodes with 25 ppm treatment. Ear number and tassel branch number decreased with increasing concentration; male sterility was significant at the 25 ppm treatment and pistillate development was marked in the few plants surviving the higher treatments. At a treatment of 125 ppm, plants were twisted and swollen at the nodes; nearly 70% of them were killed by the tenth to twelfth treatment. Of those surviving, most failed to exsert a tassel. The same effect, only more pronounced (90% kill), occurred with 625 ppm plants. A few plants in both 25 ppm and 125 ppm groups gave no visible response to the treatment. Aside from modified tassels, these survivors resembled the controls. Rejected plants generally did not exsert tassels; when these were dissected and examined, they were found to be composed of pistillate rudiments and were apparently male sterile. Ears were alike in appearance in controls and with 5 ppm and 25 ppm treatments. No ears were matured at higher concentrations.

Inbred L317. (Tables 1, 6; Fig. 1; Plates 5, 10). Response in height was greatest at the lowest treatment of 5 ppm. Vegetative growth was affected above that point, with higher treatments increasingly effective in producing twisted and contorted plants which generally died. Plants did not form tillers on either controls or test plants. Brace roots were formed at the lowest 1 or 2 nodes of controls and at the lowest three nodes in both 5 ppm and 25 ppm treatments. Male sterility and pistillate development increased with higher concentrations. The same situation mentioned above occurred here also; two plants out of 50 given the 625 ppm treatment did not die but became about 20% taller than the controls. Rejected plants generally did not exsert tassels. Upon dissection, these tassels were found to be rudimentary, mostly pistillate, and apparently male sterile. Ears were alike in controls and 5 ppm plants, but did not mature at higher concentrations.

Discussion and Conclusions:

GA causes marked response in stem elongation, but its effect is dependent both upon the race of maize studied and the concentration of GA employed. Total height is in itself a nebulous measure of elongation effects in GA-treated plants. Internode diagrams (Anderson and Schregardus, 1944) provide a means for more direct comprehension of just where growth is increased. Brian et al. (1958) maintained that GA did not delay maturation of pea internodes but rather matured them early. They reported that the rate of extension was speeded up. The same may be true in maize, because internodes did not elongate indefinitely. Plate 1 shows that the elongation was extremely rapid. Internode diagrams were constructed whenever possible for five plants of each of the treated groups of each maize type. One representative diagram of each group is shown in Fig. 1. These were constructed from the tassel down, hence the internodes were drawn in the inverse order of their appearance, and tassels are at the same relative position on each graph.

The top row represents controls in each maize type. Spancross and Parker's Flint essentially exhibit increasing internode lengths from base to top of plant. Zapalote Chico reaches a maximum below the ear then shows a succession of shorter internodes up to the peduncle, the internode just below the tassel. CC5 has a slightly modified Parker's Flint curve; L317 has gradually elongating internodes up to the ear, then shortening internodes to the tassel. A vertical comparison of diagrams in each column will show what concentrations affected which internodes within one kind of maize; horizontal comparisons will show how the various maizes responded to the same concentration of GA.

In Spancross, 5 ppm gave an increase in all internodes except the lowest and highest. With 25 ppm, greater elongation occurred in the internodes below the ear compared with controls. This trend was accentuated by the 125 ppm and 625 ppm concentrations. With the latter concentration, internode elongation above the ear fell off drastically, with a slight recovery noted in the peduncle.

In Parker's Flint, the 5 ppm and 25 ppm concentrations caused general increase in all internode lengths. Extra internodes were apparently formed under all treatments, always below ears. Brian (1957) reported that GA had no effect on internode number in peas. In maize, these extra internodes were found not to be expansions of normally short internodes at the base of the plant, but new ones added in between the established base of the plant and the node bearing the ear, apparently before differentiation by the meristem of tassel and ear primordia. 125 ppm on Parker's Flint caused a rapid decline in vegetative growth after initial rapid and extreme elongation. With 625 ppm, the plants exhibited three peaks of elongation; one early, one associated with the ear node and one associated with the peduncle.

In Zapalote Chico, nodes below the ear were stimulated with 5 ppm. With 25 ppm, this stimulation was more marked; an early peak was followed by decreases in length up to the ear node, after which the same pattern already noted took place. The 125 ppm treatment produced marked early elongation, followed by a gradual dropping in length of most subsequent internodes and a slight upturn associated with the peduncle. 625 ppm produced the greatest initial elongation, but after a peak the drop in rate was rapid, again with a slight upturn associated with the peduncle.

In CC5, 5 ppm and 25 ppm caused marked elongation of early internodes, but this effect did not persist. Both above and below the ear node, variations seen in the successive lengths of control internodes were accentuated. The 125 ppm concentration, which only 4 plants survived, showed extensive early elongation followed by a steady decline.

In L317, lower internodes were stimulated only slightly by 5 ppm, while internodes *above* the ear increased in length along the same pattern as controls. At 25 ppm, the four internodes *below* the ear showed most elongation; the lowest internodes were apparently inhibited by GA.

The greatest elongations were not obtained under poor growing conditions, which Applegate (1958) and Wittwer and Bukovac (1958) noted were apparently best for maximum expression of the potentialities of GA. The plants in this experiment had soil moisture and temperatures optimum for maize growth when the effects noted above were being manifested. In summary, the same internodes of one kind of maize reacted differently but characteristically to each of the concentrations of GA employed. When homologous internodes of two kinds of maize are compared, their reaction to a particular concentration of GA was also different but characteristic for each maize.

The higher concentrations of GA tended to weaken plants, reduce growth in length, cause swelling at nodes, twisting of culms, poor leaf blade development (rolled, narrow and with various degrees of chlorosis), and brittle leaf sheaths which often separated from the culms. Inbreds responded most drastically to these concentrations and were either killed or greatly reduced in size; the hybrid was least affected. Survival of a few inbreds among populations which were essentially wiped out by certain treatments probably indicates a history of non-selection for physiological variability within morphologically constant plants.

The inflorescences developed by treated Spancross plants may be of some importance to students of maize history, because large-glumed strawberry-like ears (with, in this case, full-sized kernels) and unbranched or slightly branched terminal inflorescences with pistillate parts below and staminate parts above are close to what Mangelsdorf (1954) has postulated as a forerunner of today's corn. The articulation of the rachis of this artificially-produced inflorescence into joints containing one pair of spikelets in the same manner as wild grasses like *Tripsacum* is of further significance. One interpretation of these observations is that GA allows genes suppressed by modifying factors to become expressed. Cases of reversion from adult to juvenile foliage by treatment with GA in *Poa pratensis* (Leben and Barton, 1957) and in *Hedera* (Robbins, 1957) and of a prolonging of the juvenile leaf form in *Ipomoea* (Njoku, 1958) and peas (Barber et al., 1958) are possibly subject to a like interpretation. The concentration of GA employed may be of significance, for relatively small amounts applied to seedlings of *Eucalyptus* were reported to bring about early development of adult foliage (Scurfield and Moore, 1958). Evolution may involve not only specific mutation of genes for particular characters from one state to another, but also a superimposing of modifications on their expression which leaves the original genes still present and basically unchanged.

In general, GA reduces branching relationships in intact maize plants, restricting formation of ears, tillers and tassel branches in inverse proportion to the concentration employed. As mentioned above, tiller formation was enhanced on decapitated plants, an observation also in line with the findings of others (Brian, 1957). Production of pistillate or mixed staminate-pistillate spikelet pairs in the tassel essentially duplicates some of the effects attributed to a recessive gene (Tassel-seed 1 or ts_1) and a dominant gene (Tassel-seed 3 or Ts_3). Significantly, ear production in both these genetic forms and the GA-produced ones is reduced (Nickerson and Dale, 1955). The development of pistillate spikelets is not too surprising, for Weatherwax (1916) pointed out the fact that all florets of maize are potentially perfect.

Brace root formation was enhanced by several different concentrations of GA applied at points well away from their areas of emergence on the plants. Their stimulation by GA agrees with the report by Whaley and Kephart (1957) who found that in culture, maize root stimulation was a function of the GA concentration. Robbins (1958) also reported stimulation of maize root growth in culture, but at relatively low concentrations of GA. Stowe and Yamaki (1957) presented conflicting evidence. Brian (1959) stated that root growth of intact plants is not known to be stimulated by GA. On the basis of the observations noted above, it seems reasonable to conclude that adventitious root formation can be stimulated by GA in grasses, with effects depending upon concentrations and the plant involved.

The induction of male sterility by GA may well have a use in hybrid corn breeding, as Nelson and Rossman (1958) pointed out. In the plants described earlier, male sterility was brought about by failure of stamens to form. Glumes, lemmas and paleas were generally formed; tassels resembled those of the recessive mutant tassel-seed 8 (ts_8) (Nickerson and Dale, 1955). Tips of branches and of central spikes on many treated plants were often sterile, even when pollen-shedding stamens occurred in the proximal parts of tassels. The effect was more pronounced with increased concentrations of GA.

These results indicate that GA is a powerful aid to morphological study in that it can cause expression of normally undeveloped plant parts and modification of basic plant structures. It further shows that consistent treatments produce consistent results, and suggests that these modified forms may be relied upon to contribute valid data to problems of plant structure.

Summary:

One hybrid, two inbreds and representatives of two exotic kinds of maize were subjected to four different concentrations of Gibberellic Acid throughout the growing season. Internode diagrams of controls and treated plants demonstrated that the increase in height which was generally observed took place neither in the same nodes for different kinds of maize nor to the same extent for particular nodes of one kind of maize subjected to different GA concentrations. A general reduction of branching occurred in all cases. High concentrations of GA inhibited vegetative growth, eventually killing some plants. The hybrid was least changed; inbreds were profoundly modified. Male sterility and pistillate florets in tassels which resembled certain dominant and recessive mutants were obtained in all groups. One group produced terminal inflorescences which in their organization and manner of articulation strongly resembled terminal inflorescences of *Tripsacum*. Brace root formation was stimulated with increased concentrations of GA.

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TABLE 2 — HYBRID SPANCROSS

Treatment in ppm of GA		0	5	25	125	625
	Height (Av. of 5 plants to nearest cm.)	89	103	136	106	84
	Number of Nodes (Av. of 5 plants)	8	8	8.6	8.8	8.4
Averages of all available plants (maximum number, 50 per column)	Number of Tillers	1.8	0.8	0.2	0.0	0.0
	Number of Ears	1.8	2.0	1.6	1.1	0.7
	Number of Primary Tassel Branches	3.2	2.0	2.0	1.7	1.5
	Percent of Tassels wholly Male Sterile	0	0	8.8	67	95
	Percent of Tassels with Functional Pistillate Florets	0	8	20	72	95
Plants discarded per group of 50	Number of Plants Dying From Treatment	0	0	1	0	5
	Number of Plants Broken by Wind	0	3	4	1	7
	Number of Plants Excluded	5	11	11	10	12

TABLE 3 — PARKER'S FLINT

	Treatment in ppm of GA	0	5	25	125	625
	Height (Av. of 5 plants to nearest cm.)	162	136	180	113	174
	Number of Nodes (Av. of 5 plants)	8	8.8	10.2	8.8	9.6
Averages of all available plants (maximum number, 50 per column)	Number of Tillers	2.9	2.2	0.7	0.2	0
	Number of Ears	2.1	1.8	1.7	0.6	0.4
	Number of Primary Tassel Branches	9.8	9	8	5	5
	Percent of Tassels wholly Male Sterile	0	0	3	79	96
	Percent of Tassels with Functional Pistillate Florets	0	0	0	16	46
Plants discarded per group of 50	Number of Plants Dying From Treatment	0	0	1	3	4
	Number of Plants Broken by Wind	0	2	6	11	9
	Number of Plants Excluded	0	2	8	17	13

TABLE 4 — ZAPALOTE CHICO

	Treatment in ppm of GA	0	5	25	125	625
	Height (Av. of 5 plants to nearest cm.)	169	186	198	248	202
	Number of Nodes (Av. of 5 plants)	11.2	12.2	13.4	14.2	13.6
Averages of all available plants (maximum number, 50 per column)	Number of Tillers	0	0	0	0	0
	Number of Ears	1.4	1.4	0.8	0.8	0.1
	Number of Primary Tassel Branches	20.6	17.8	14.7	15.9	8.8
	Percent of Tassels wholly Male Sterile	0	0	0	38	79
	Percent of Tassels with Functional Pistillate Florets	0	0	0	3	63
Plants discarded per group of 50	Number of Plants Dying From Treatment	0	0	0	1	8
	Number of Plants Broken by Wind	0	0	13	11	7
	Number of Plants Excluded	0	0	4	9	16

TABLE 5 — INBRED CC5

Treatment in ppm of GA		0	5	25	125	625
	Height (Av. of 5 plants to nearest cm.)	150	141	162	Insuff. No. of plants	Insuff. No. of plants
	Number of Nodes (Av. of 5 plants)	12.4	12.6	12.6	Insuff. No. of plants	Insuff. No. of plants
Averages of all available plants (maximum number, 50 per column)	Number of Tillers	0	0	0	0	0
	Number of Ears	1.8	1.5	0.7	0	0
	Number of Primary Tassel Branches	6.7	4.6	5.0	5.2	0
	Percent of Tassels wholly Male Sterile	0	0	80	100	0
	Percent of Tassels with Functional Pistillate Florets	0	0	7	100	0
Plants discarded per group of 50	Number of Plants Dying From Treatment	0	3	8	34	45
	Number of Plants Broken by Wind	1	5	12	2	0
	Number of Plants Excluded	1	3	15	10	5

TABLE 6 — INBRED L317

Treatment in ppm of GA		0	5	25	125	625
	Height (Av. of 5 plants to nearest cm.)	154	161	144	Insuff. No. of plants	Insuff. No. of plants
	Number of Nodes (Av. of 5 plants)	13.4	13.2	13.0	Insuff. No. of plants	Insuff. No. of plants
Averages of all available plants (maximum number, 50 per column)	Number of Tillers	0	0	0	0	0
	Number of Ears	1.3	1.1	0.5	0	0
	Number of Primary Tassel Branches	9.1	5.9	4.4	0	8.5
	Percent of Tassels wholly Male Sterile	0	0	32	100	100
	Percent of Tassels with Functional Pistillate Florets	0	0	12	100	100
Plants discarded per group of 50	Number of Plants Dying From Treatment	0	5	8	41	39
	Number of Plants Broken by Wind	0	1	4	0	1
	Number of Plants Excluded	7	5	17	7	8

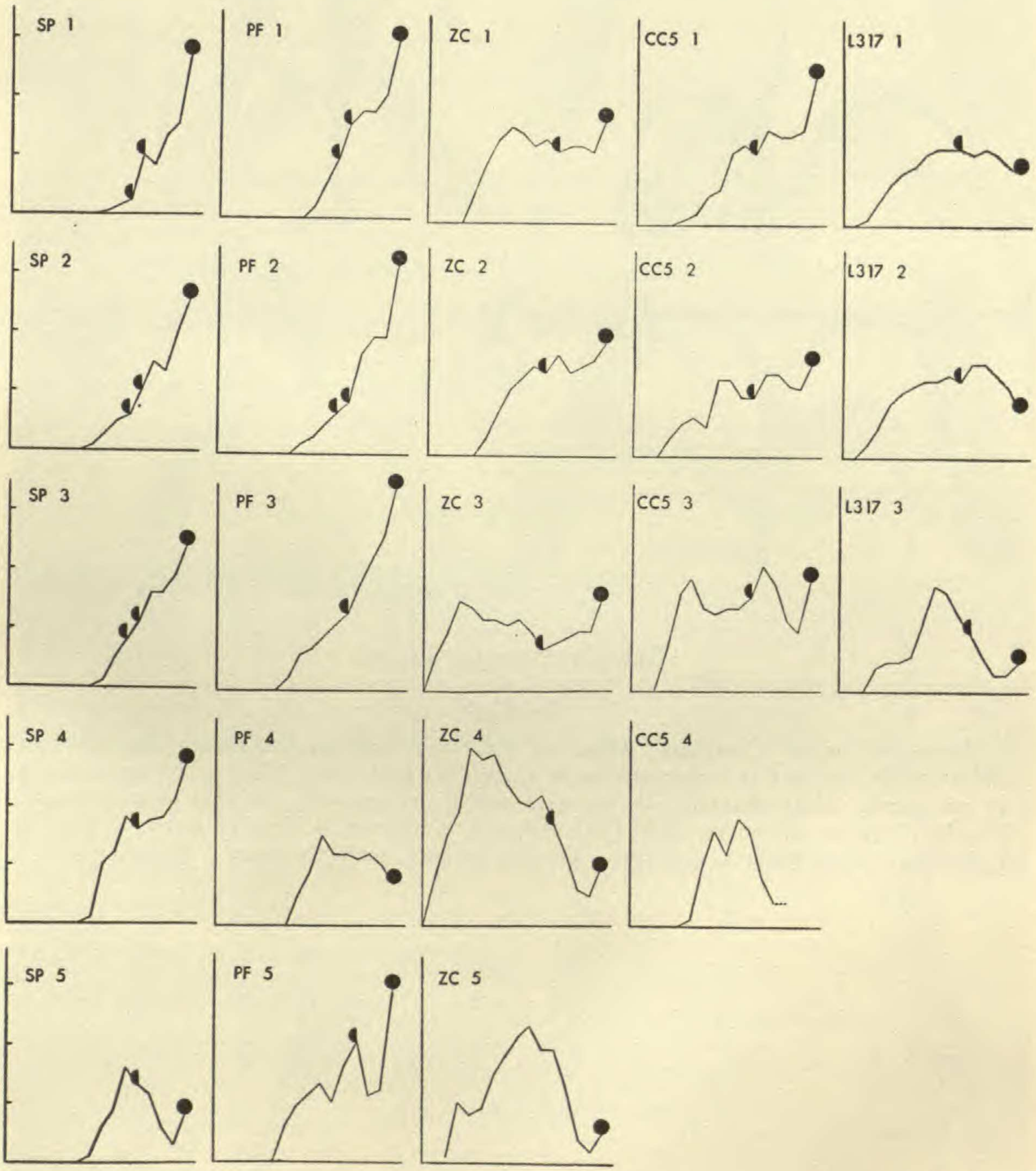


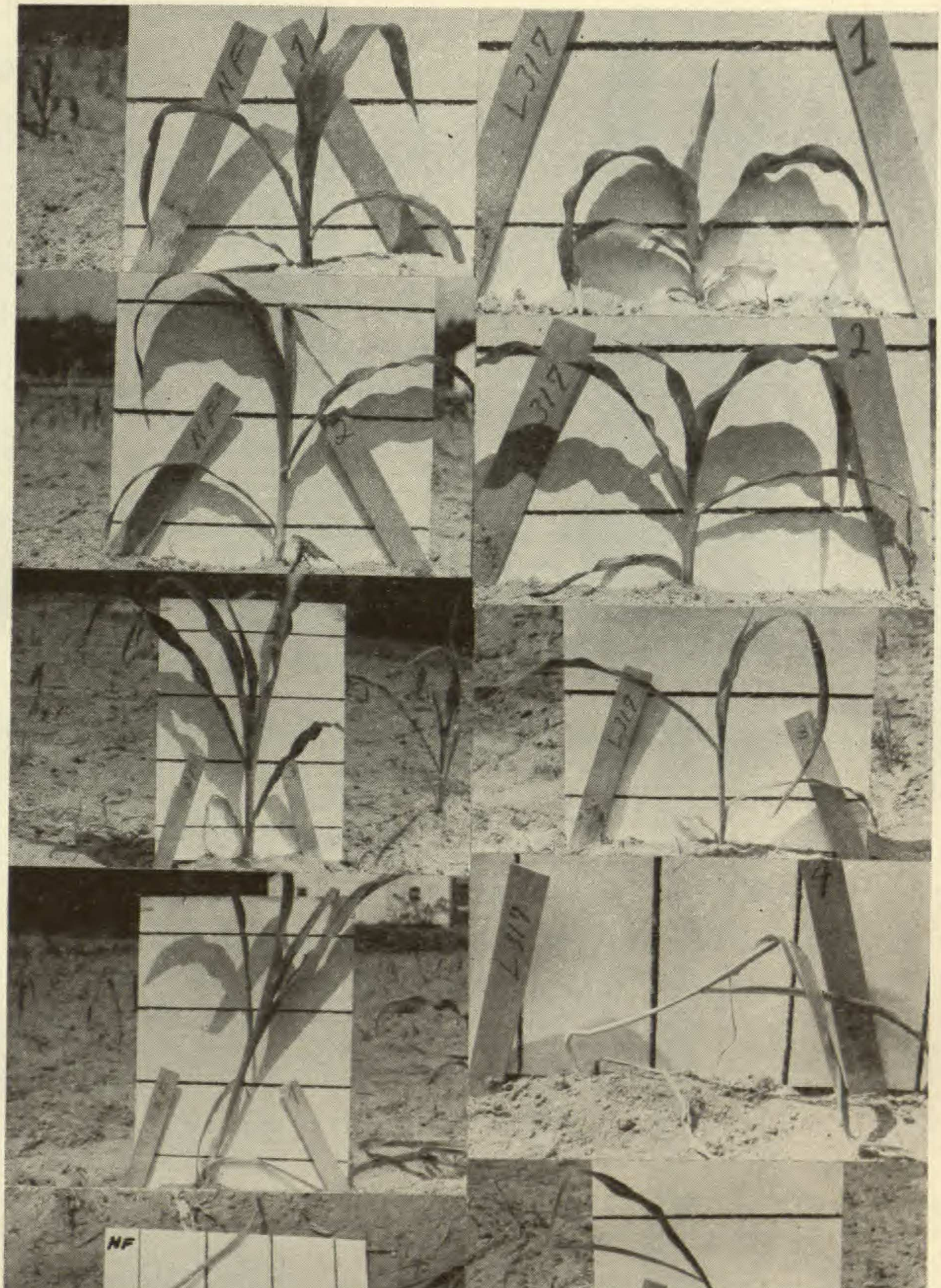
Fig. 1. Internode Diagrams of control (top row) and GA-treated maize plants. Horizontal axis is internode number. Vertical axis is internode length in cm.; each division is 10 cm. Circle denotes tassel; semicircle denotes ear.

Sp, Spancross; PF, Parker's Flint; ZC, Zapalote Chico; CC5 and L317 are standard inbred lines. Number 1 stands for distilled water (controls); 2 for 5 ppm GA; 3 for 25 ppm GA; 4 for 125 ppm GA; 5 for 625 ppm GA. Further explanation in the text.

Explanation of Plate

PLATE 5

Plants of Parkers (Northern) Flint and L317 four and one-half weeks after planting and after six consecutive treatments every three days with GA. Lines on background are 10 cm. apart. Note characteristic elongate and angled growth at higher concentrations. Numbers refer to concentration of GA employed, as follows: 1, distilled water; 2, 5 ppm; 3, 25 ppm; 4, 125 ppm; 5, 625 ppm. Further explanation in the text.



NICKERSON—TREATMENT WITH GIBBERELLIC ACID

NICKERSON—TREATMENT WITH GIBBERELLIC ACID

EXPLANATION OF PLATE

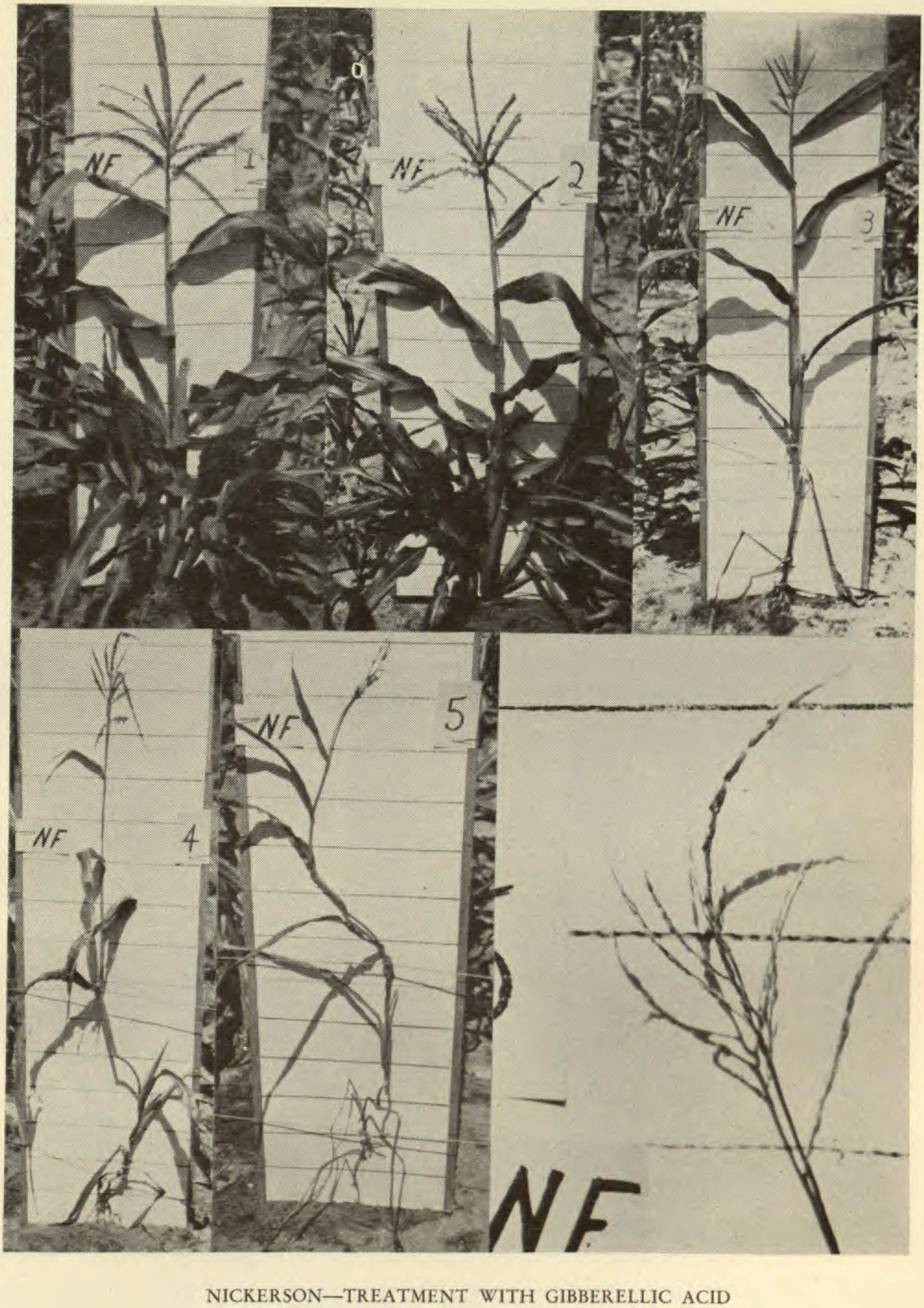
PLATE 6

Mature plants of Spancross from each GA treatment. Lower right-hand figure shows *Tripsacum*-like tassel common in plants receiving 125 ppm of GA. Numbers refer to concentrations of GA employed as follows: 1, distilled water; 2, 5 ppm; 3, 25 ppm; 4, 125 ppm; 5, 625 ppm. Lines on background are 10 cm. apart. Further explanation in the text.

EXPLANATION OF PLATE

PLATE 7

Mature plants of Parker's (Northern) Flint from each GA treatment. Lower right-hand figure shows male-sterile tassel commonly developed at higher concentrations of GA. Numbers refer to concentrations of GA employed, as follows: 1, distilled water; 2, 5 ppm; 3, 25 ppm; 4, 125 ppm; 5, 625 ppm. Lines on background are 10 cm. apart. Further explanation in the text.



NICKERSON—TREATMENT WITH GIBBERELLIC ACID